EAST AFRICAN SCHOOL OF AVIATION EXAMINATION

END TERM II EXAMS

DIPLOMA IN AURONAUTICAL ENGINEERING AVIONICS

Engineering Mathematics

STREAM: Year (Airframes & Engines) **Duration: 3HRS**

DAY/DATE: 05/04/2017 **TIME: 9.00 – 12.00PM**

INSTRUCTION TO CANDIDATES

You should have the following for this examination:

Answer booklet;

Mathematical tables / Electronic calculator.

Answer ***ALL THE QUESTIONS*** *in this paper*

All questions carry equal marks.

Maximum marks for each part of a question are as shown

Smith chart

This paper consists of - printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

*Answer any **FIVE** questions*

1. (a) Find the general solution of the differential equation

$$(4y+3x)\frac{dy}{dx}=3x-y$$ **(9 marks)**

(b) The displacement x metres of a body fixed from a point 0 at any time t seconds satisfies the differential equation

$$\frac{d^2x}{dt^2}-2\frac{dx}{dt}+10x=\sin 3t \ .$$

Use the method of undetermined coefficients to find an expression for the displacement x(t)

(11 marks)

2. (a) show that the solution to the differential equation

$(3y^2+4xy)dx+(2xy+x^2)dy=0$ takes the form $x^3y(x+y)=k$, where k is a constant

(9 marks)

(b) Use the method of undetermined coefficients to obtain the general solution of the differential equation:

$$\frac{d^2y}{dx^2}-2\frac{dy}{dx}+2y=6x^2+4$$ **(11 marks)**

3) a) Table 1 satisfies a function f(x).

x	-2	0	2	4	6	8	10
f(x)	6	8	10	60	206	496	978

Use the Newton-Gregory forward difference interpolation formula to determine the value of:

I. f(-1.8)

II. f(8.2) **(12 marks)**

b) Given that x_n is an approximation to the root of the equation $x^2+5x-20=0$,

I. show, using the Newton-Raphson method, that a better approximation is given by

$$X_{n+1}=\frac{3X_n^4+20}{4X_n^3+5}$$

II. Taking the first approximation $x_0=1.9$, find, to 5 decimal places, the root of the equation. **(8 marks)**

4. (a) Taking -1.2 as the first approximation to the negative root of the equation $14x^3 - 11x^2 + 22 = 0$, use Newton-Raphson method to evaluate the root correct to four decimal places

(8 marks)

(b) Table below shows data obtained in an experiment. Use Gregory- Newton interpolation formulae to evaluate **(12 marks)**

I. f(-0.35)

II. f(x)

t	-0.5	-0.3	-0.1	0.1	0.3	0.5	0.7
f(t)	2.125	0.813	-0.189	-0.131	-0.147	0.525	2.653

5. Sketch the graph of the function

$F_{(t)} = t^2 - 4t + 3 \qquad 0<t<4$

$F_{(t+4)}$

In the interval -4 < t < 8 and hence.

Find its Fourier series representation

Use the above results to show that

$$\frac{\pi^2}{6} \sum_{n=1}^{\infty} \frac{1}{n^2}$$

6) a) if $\phi = x^2 y + xz^2$ determine grad ϕ at the point P(1,3,2) **(4 marks)**

b) if $\mathbf{A}=\begin{bmatrix} 1 & 2 & 3 \\ 4 & 6 & 7 \\ 5 & 8 & 9 \end{bmatrix}$ and $\mathbf{B}=\begin{bmatrix} -2 & 6 & -4 \\ -1 & -6 & 5 \\ 2 & 2 & -2 \end{bmatrix}$

Verify that AB=kI where I is a unit matrix and k is a constant. Hence solve the equations.

$$x_1 + 2x_2 + 3x_3 = 2$$
$$4x_1 + 6x_2 + 7x_3 = 2$$
$$5x_1 + 8x_2 + 9x_3 = 3$$

(10 marks)

c) Three coplanar vectors are

$X = 2i - j + 3k$

$Y = ai + 2j + k$

$Z = i - 3j + 4k$

Determine the value of a. **(6 marks)**

******End******